Beaumont

1931

SEALE-HAYNE AGRICULTURAL COLLEGE

NEWTON ABBOT, DEVON.

DEPARTMENT OF PLANT PATHOLOGY

EIGHTH ANNUAL REPORT

FOR THE YEAR ENDING SEPTEMBER 30th, 1931.

Pamphlet No. 37.

SEALE-HAYNE AGRICULTURAL COLLEGE.

Department of Plant Pathology.

Advisory Entomologist :

W. E. H. HODSON, A.R.C.S., D.I.C. to March, 1931.

L. N. STANILAND, A.R.C.S., D.I C. from May, 1931.

Advisory Mycologist :

A BEAUMONT, M.A. (Cantab.)

Eighth Annual Report of the Department of Plant Pathology.

ADVISORY WORK.

Statistics of advisory letters and visits are as follows:—

Advisory Letters.	*Entomological.*	*Mycological.*
Devon	126	173
Cornwall	52	64
External	33	43
Total	211	280
Advisory Visits.		
Devon	104	82
Cornwall	48	75
Total	152	157

About one-third of the letters related to the flower industry as was the case the previous year.

LECTURES.

In the College the usual courses were given, and the Entomologist gave lectures and demonstrations on the dissection of bees to the Short Course in Beekeeping. External lectures were given by the Entomologist at

Sidmouth Junction	Pests of Farm Crops.
Holsworthy	do.
Blackawton	do.
Uplyme	Garden Pests.
Torquay	do.
Penzance	Narcissus Flies.

External lectures by the Mycologist were given at

Cadeleigh	Diseases of Farm Crops.
March, Isle of Ely	do.
Yelverton	Diseases of Garden Crops.
Uplyme	do.
Paignton	do.
Newton Abbot	do.
Filleigh Women's Institute	do.

A paper on "The Cost of the Control of Plant Diseases" was given at the Advisory Mycologists' Conference in London.

SHOWS.

As before exhibits were staged at the Commercial Horticultural Shows in Penzance in March and Plymouth in April. A special exhibit of Tulip diseases and Narcissus Flies was shown

in the Scientific Tent in the Royal Horticultural Society's Flower Show at Chelsea. Specimens were sent to the Newton Abbot Allotments Society's Show.

WOOLY APHIS PARASITE.

Weather conditions during the year have been unfavourable to the welfare of the colony of the Woolly Aphis parasite, *Aphelinus mali*, near Barnstaple. In the Seventh Annual Report it was stated that the parasite had spread to other orchards. As the result of excessive rain and strong winds, the number of parasites in the orchard has been considerably reduced and its spread has been checked.

HOT WATER TREATMENT OF STRAWBERRY RUNNERS.

The treatment of strawberry runners by immersion in hot water as a possible control measure of the mite, *Tarsonemus fragariae* is being continued on a somewhat larger scale. Particular attention is being given to the time of year at which the treatments take place.

BRACKEN INOCULATIONS.

The artificial infection experiments described in the last Annual Report were repeated on the same farm in East Devon on two different dates. This time the results were negative.

PUBLICATIONS,

HODSON, W. E. H.

A Comparison of the Immature Stages of *Eumerus tuberculatus* Rond., and *Syritta pipiens* Linn. (*Syrphidae*). Bulletin of Entomological Research, vol. xxii., 1931, pp. 55-58.

A New Method of Preventing Attacks of Bulb Flies on Narcissus. Journ. Ministry of Agric., xxxviii, April, 1931, 54-60.

The Stem and Bulb Eelworm, *Tylenchus dipsaci* (Kuhn) Bastian. A further contribution to our knowledge of the Biologic Strains of the Nematode. Annals of Applied Biology, xviii, 1931, pp. 83-97.

Articles in the Seale-Hayne College Monthly Bulletin on "Poison Bait for Leather Jackets and Slugs," "Lime Washing Farm Orchards," "Big Bud," "Poison Bait for Bulb Flies."

STANILAND, L. N.

Article on "Codlin Moth" in the Seale-Hayne College Monthly Bulletin.

BEAUMONT, A.

Articles in the Seale-Hayne College Monthly Bulletin on "Black Leg in Mangolds," "Silver Leaf," "Finger-and-Toe," "Spraying for American Gooseberry Mildew."

Article on "Black Leg in Mangolds" in the South Devon Milk Recording Society's Official Year Book, 1931.

Some of the above articles have been reprinted in other journals.

Notes on Pests during the Year.

CEREALS.

Cereal crops, in particular autumn sown oats after ley, were very severely damaged throughout Devon by wireworms, *Agriotes* spp. Slugs of various species were exceptionally numerous and damage was severe and general. Leather-jackets, *Tipula* spp., have also caused a certain amount of damage to cereals. A case of Tulip Root on oats, *Tylenchus dipsaci*, occurred in the Crediton district. Other cereal pests were not markedly abundant.

PULSE.

Pea Thrips, *Frankiniella robusta*, caused a considerable amount of damage in both Devon and Cornwall. Bean Aphis, *Aphis rumicis*, has been noticeably slight and, where present, has been rapidly checked by Ladybirds, *Coccinellidae*.

ROOT CROPS.

Pigmy Mangold Beetle, *Atomaria lineata*, again destroyed many acres of mangold and sugar beet. Cutworms, *Agrotis* spp., were also responsible for much damage to a variety of root crops in Devon and Cornwall. Slugs were serious in all districts. Carrot Fly, *Psila rosae*, on carrots and parsnips was a serious vegetable pest.

BRASSICAE.

Brassicae again suffered heavy losses. Root Fly, *Hylemyia brassicae*, was everywhere abundant and destructive. Gall Weevil, *Ceuthorrhynchus pleurostigma*, was very injurious throughout commercial seed-beds in Cornwall. White Butterflies, *Pieris* spp., were of little importance during the year. Cutworms, *Agrotis* spp., did much damage to broccoli in Cornwall.

FRUIT.

On the whole pests of fruit were of normal incidence. Capsid Bugs, *Plesiocoris rugicollis* and *Lygus pabulinus*, continue to increase. Apple Blossom Weevil, *Anthonomus pomorum*, is increasing in North Devon, and has in many orchards reached serious proportions. Slugworm, *Eriocampa limacina*, was serious in Devon. Severe attacks of Gooseberry Sawfly, *Pteronus ribesii*, took place in the Tamar Valley. Leaf-eating caterpillars were less prevalent than in the previous year.

FLOWERS, Etc.

Chrysanthemums suffered severely from Capsid Bug, *Lygus pratensis*, aphids and Eelworm, *Aphelenchus ritzema-bosi*. An unusual pest was the cockroach, *Blatta orientalis*, which destroyed quantities of sweet pea seed under glass. Bulb Fly damage has not been so severe as in the previous year. The damage which has occurred is largely due to attacks by the Lesser Bulb Fly, *Eumerus* spp. Greenhouse White Fly, *Trialeurodes vaporariorum*, was abundant. Some severe cases of Thrips damaging tomatoes under glass were observed.

MISCELLANEOUS.

Wasps were remarkably scarce. Several nests of the Hornet, *Vespa crabro*, were reported in South Devon.

The Large Bulb Fly Merodon Equestris.

The investigation of the life history of this fly has been completed and the work is now being prepared for publication in extended form.

In brief, it has been established that there is but one generation of the fly a year, and that the normal flight extends from the first week in May until the end of June. A female fly lays on the average 40 eggs. Larvae enter the bulbs via the base plate, leave usually through the base but sometimes the neck, and pupate at the surface of the soil at some distance from the bulb. Migration from the bulbs commences as early as mid-February in the extreme South-West of England and is at its maximum during March.

With the co-operation of the Cornwall County Council, an extended trial of the "poison bait" method of control, suggested in last year's report (Pamphlet No. 36) was made. The trial falls under three main headings.

(*a*) Spraying carried out by County Council officials at a charge of 5s. per acre. 70 acres of growing bulbs were sprayed. Numbers of dead flies were found after spraying and bulbs from sprayed gardens were found on subsequent examination to compare very favourably with ones unsprayed.

(*b*) Spraying by individual growers in Cornwall. At least 100 acres were sprayed, and whilst accurate figures are not obtainable it appears that a material reduction in bulb fly population was effected.

(*c*) Sprayings carried out in other districts. Some 20 acres were sprayed and no reports of severe infestation subsequently have been received.

The spray recommended is comprised as follows:—

	Cost.
Sodium arsenite (4 ozs.)	5d.
Glycerine, crude (1 lb.)	8d.
Sugar (White cane) (2 lbs.)	5d.
Water (4 gals.)	—
Total cost	1s. 6d.

It is recommended that six sprayings be made at weekly, or five at 10 day intervals commencing about May 15th. In trials in series (*a*), 6 gallons of spray per acre were used on the average at each spraying, and 1 hour was occupied in spraying an acre. At the other extreme a grower of valuable stocks sprayed 8 times, using each time 16 gallons per acre and took 5½ hours per acre. It is suggested that a commercial grower should use from 8 to 10 gallons per acre for each spraying.

A high measure of control is apparently effected by spraying alone, but in order to effect a substantial reduction of flies throughout bulb growing districts the following measures are suggested as being suitable for adoption as routine procedures.

CONTROL MEASURES.

(*a*) Bulbs should be subjected to the "hot water treatment" whenever they are lifted. In practice this will be every second or third year, and will ensure complete freedom from infestation in newly planted stocks.

(*b*) In the subsequent season or seasons when the bulbs remain in the ground special attention should be paid to surface cultivation of the soil during the whole of the period during which ovipositing flies are likely to be present.

(*c*) Periodic spraying with the poison bait spray should be resorted to, whether the bulbs be due for lifting or not. Sprayings should be made at approximately weekly intervals, the exact dates being determined by the weather conditions prevailing.

The sprayings should commence and terminate at approximately the times previously mentioned, viz., the second week in May and the last week in June, or first week in July.

(*d*) In certain cases, e.g., where lifted bulbs are to be forced and are known to be free from bulb eelworm, fumigation might perhaps with advantage be substituted for the hot water treatment.

Notes on Fungal Diseases during the Year.

The amount of rain throughout the season was larger than in any previous year since 1924. Diseases like Potato Blight and Black Currant Leaf Spot were therefore exceptionally severe, but on the whole the losses from disease were less than in 1924. This was especially the case with fruit trees. The direct effect of excess rain was responsible for appreciable reduction of several crops.

The rainfall at Seale-Hayne College may be compared with that of 1924.

	1931	1924
March	2.60 in.	1.99 in.
April	3.47	3.33
May	2.92	4.86
June	3.61	2.01
July	5.32	3.96
August	4.80	2.62
September	1.15	5.35

The first three months did not differ much from 1930, and the amount of disease on flower and fruit crops was very much the same. The exceptional rainfall of July and August was probably responsible for the severe losses from Potato Blight. The rainfall of May, 1924, was much higher than that of May, 1931, and explains the greater amount of Blossom Wilt and other spring fruit diseases in the earlier year.

CEREAL DISEASES.

Quite insignificant except for one or two cases of Barley Leaf Stripe.

POTATO DISEASES.

1931 was an exceptionally bad Blight year comparable with 1924 and 1920. The disease appeared in West Cornwall at about the usual time, May 12th. The local outbreak was checked but the fungus appeared again at the end of the month over a wide area and affected the crop.

In Devon the outbreak was earlier than has been recorded since 1920. It was observed at Seale-Hayne College on June 10th, at Braunton about the same date, at Hele on June 15th and at Totnes on June 20th. It is said to have started on early

potatoes at Branscombe on May 27th. The main epidemic was in the middle of July and in August ; it was common even on high ground. In places where the disease appeared early the crop was negligible, except where spraying and dusting had been carried out. For example, a field of Epicure sprayed twice gave 10 tons per acre ; if it had not been sprayed there would have been no ware crop at all. Even in the Moretonhampstead area, where the disease is later in appearing, a plot dusted as late as September 18th gave 1½ tons per acre more than the unsprayed plot. Unsprayed crops also suffered severely from disease in the tubers, particularly on the heavier soils.

The canker form of Corky Scab was common in gardens in August. It was often mistaken for Wart Disease.

A case of Spraing from Budleigh Salterton, Devon, is of interest, as the only previous record in Devon is from the same district. The soils here are poor and sandy and short of organic matter.

DISEASES OF ROOT CROPS.

Black Leg of Mangolds did even less damage than last year, though it was rather more frequent in its appearance. *Pythium de Baryanum* was chiefly observed. The chief losses in this crop were due to local thunderstorms in the spring and the cold, wet summer. Mangold Rust was unusually scarce and Heart Rot was not not observed.

In January, 1931, in South Devon one third of a ten-acre field of swedes, variety Devon Champion, was destroyed by a bacterial disease corresponding in symptoms to Black Rot. The latter is usually ascribed to *Pseudomonas campestris*, but Dr. S. G. Paine, to whom specimens were sent, isolated only *Bacillus carotovorus*, the Soft Rot organism. The exact cause of the decay could not, therefore, be ascertained. The field was not short of lime and no finger-and-toe was present. The disease had not previously been observed on the farm and was not found in any other district.

DISEASES OF BEANS AND PEAS.

For the first time since 1924 there were several cases of severe epidemics of Chocolate Spot, the disease sweeping over the fields remarkably swiftly and producing nearly a total loss. In each case the soil was exceedingly short of available potash.

Downy Mildew of Peas was common in some districts.

DISEASES OF PASTURES.

Rye-grass rust (*Puccinia Lolii*) was very prevalent in September, the growth of grass from the wet summer being too large to be kept down by grazing.

DISEASES OF VEGETABLES.

Bacterial Leaf Spot (*Bacterium marginale*) on Lettuce was common during the winter, especially in West Cornwall. The variety, Winter Standwell, was susceptible but recovered later, while Trocadero was fairly resistant. Lettuce Ring Spot (*Marssonina panattoniana*) was observed for the first time. It had, however, been noticed by the grower during several previous seasons, the first time being in 1919. The first published record of the disease out of doors in Great Britain was for Kent in 1922.

Broccoli diseases were more severe than usual. White Rust (*Cystopus candidus*) was very common, but of little economic significance. Bacterial Soft Rot was very severe, causing the heads to be spoiled before marketing as well as the usual heavy losses to the seed crop. The Roscoff varieties of broccoli continue to be resistant to Ring Spot (*Mycosphaerella brassicicola*).

Lack of sunshine and high atmospheric humidity were very unfavourable to the tomato crop. It was necessary to keep the houses heated to a much later date than usual, and those growers who omitted this precaution suffered from " hardening " of the growth and leaf curling as well as an increased incidence of the grey mould (*Botrytis cinerea*) on both fruit and stems. Potato Blight appeared inside the houses in September ; fortunately, owing to the season very few plants were grown out of doors. Tomato rust (*Cladosporium fulvum*) was exceptionally severe, complete ventilation in many localities failing to control the disease. Sleepy Disease was common, but was combated with a good deal of success by keeping the houses warm and earthing up the plants affected. A severe case of Mosaic was observed in South Devon, the disease appearing after " stopping " and destroying the crop of the whole house. Insects, including white fly, were numerous, and may have produced the rapid spread of the disease.

FRUIT TREE DISEASES.

American Gooseberry Mildew did not appear till the end of May. Like last year, the attack was slight, but there was an increase on the young shoots after the fruit had been picked in many gardens.

Apple Mildew and Blossom Wilt were again insignificant. Brown Rot was early in appearing and was rather severe in July, but was uncommon in later months. Apple Scab was not as bad as in 1924, though worse than in any subsequent year ; the susceptible varieties suffered severely, although it is difficult to estimate the losses as the crop in most districts was much below normal. Observations of the perithecia on decayed leaves were carried out up to May 16th ; no spores were found before May, and then they did not appear to be mature. Canker was very

prevalent exactly as in 1930. In the autumn of 1930 there were several cases of Sooty Blotch on apple fruit ; the causative fungus could not be identified.

Black Currant Leaf Spot has not been so serious since 1924, the leaves being defoliated in some cases before fruit picking was finished.

Plum Rust was very common at the end of the summer, but defoliation was usually due to lack of potash, the symptoms of which were very evident this season. Leaf Scorch was also bad on apples, as well as " Cox spot " and similar lesions caused by the excessive rain.

Cluster-cup rust on Gooseberries, usually very scarce or absent, occurred frequently. Growers in North Devon had never seen it before.

The Leather Rot of Strawberries (*Phytophthora*) was as severe as last season, and still more widely distributed, weather favourable to the disease prevailing over a much larger area. Serious losses were confined to the older plantations, where they ranged from 25% to 99%. The disease was completely prevented by the use of straw. Further details are given on a later page.

DISEASES OF FLOWERS.

In the spring of 1931 the fungal diseases of flowers were exceptionally severe, the losses in West Cornwall being probably greater than in any previous season. This is to be ascribed to the high humidity which prevailed particularly in the extreme West.

The most serious disease of all was Iris Rust (*Heterosporium gracile*). This appeared as early as the middle of March in West Cornwall and made rapid progress in April and May, in spite of spraying. Fears were entertained that the flowers might be prevented from forming, and the crop was certainly reduced in quality owing to the presence of the disease on the flower stalks. The date of the appearance of the disease was earlier than in any season since 1928, and the losses were even more severe than in that year. No district escaped and all varieties suffered, except the earliest such as Wedgwood. The other foliage disease of Iris caused by *Mystrosporium adustum* was also common. It is easily confused with Rust, but does not assume such epidemic proportions.

Tulip Fire appeared in the College plots in a second-year bed on February 22nd. It appeared in most districts in March, and the period from March 18th to April 10th being cool and moist gave very favourable conditions for its spread. Spotted blooms comprised most of the crop in West Cornwall, where a high humidity and earlier flowering make the control of Fire very difficult. In

other parts of Cornwall and in Devon clean crops were marketed where the normal precautions were taken. Late planted tulips showed less Fire, but were later in flowering, the time of emergence of the shoots through the soil being later than with the normal plantings. A small field of tulips near Penzance planted as late as the middle of December gave a satisfactory crop of clean bloom.

Narcissus Leaf Scorch (*Stagonospora Curtisii*) was less severe generally than last year, but the flower crop of Horace and Ornatus again suffered from the fungus early in April in West Cornwall. Similar spotting occurred in other districts a little later, the variety Lucifer also suffering severely.

Narcissus White Mould (*Ramularia Vallisumbrosae*) appeared in the Scilly Isles in mid-February, and in West Cornwall and the Tamar Valley on March 27th. Pheasant's Eye suffered severely as usual, but in general the incidence of the disease was below normal. A large number of observations have now been collected, which show that the disease is not likely to become an epidemic in beds, which are lifted not later than the end of the third year and in which the same variety is not replanted a number of times. Rotation of crops and of varieties is, therefore, strongly advised. Furthermore, hot water treatment, perhaps owing to its stimulating effect on the bulb, has been observed to be beneficial. In general any cause which weakens the plants, as for example, eelworm or overcrowding, makes them more liable to an epidemic.

Narcissus Fire (*Botrytis polyblastis*) was obesrved in several localities, where it caused the foliage to turn yellow very quickly compared with the normal. White Root Rot (*Rosellinia necatrix*) was not observed.

A spell of very cold weather early in March did considerable damage to narcissi, especially in the extreme West of Cornwall, where many varieties were too far advanced to recover. The foliage of Henry Irving was killed in some cases and a small field of Ornatus Maximus in flower bud was completely ruined.

Root Rot was frequently met with, especially in Ornatus. In each case the fungus *Ramularia macrospora* was isolated free from other species, though bacteria were generally abundant. Some beds of Sunrise were seriously affected in the Scilly Isles, where the disease seemed to persist in certain patches of soil. Hot water treatment and planting elsewhere gave complete recovery. Some Dutch Iris plants which had followed affected Sunrise were examined; the plants were normal, but some slightly decayed roots were found from which *Ramularia macrospora* was isolated.

Muscari and Hyacinth are useful early greenhouse crops, which do not offer as a rule any trouble in their cultivation. A number of boxes of each crop were spoilt this season before forcing

owing to Soft Rot caused by *Bacillus carotovorus*. The exceptionally mild wet autumn of 1930 was probably very favourable to the disease. The outer parts of the bulbs became soft and slimy and the shoots turned yellow from the tip. Muscari in the open ground were healthy. The progress of the disease ceased at the end of the autumn, but affected bulbs did not recover and had to be destroyed.

The spring spore stage of Plum Rust (*Puccinia Pruni-spinosae*) is very common on Anemones, which assume a different appearance and do not flower. The anemone crop is much more valuable than the plum, so that it is better to destroy the latter. The only alternatives are to treat the crop as an annual and sow fresh seed each year or to buy fresh corms from other districts free from the disease.

The violet leaf spot fungus (? *Ascochyta Violae*) is very irregular in its appearance, and in spite of a wet autumn it was much below normal. Suddenly at the beginning of April many plantations became covered with black spots, very minute but exceedingly abundant. Attempts to cultivate the fungus failed, so it could not be ascertained if this was another stage of the leaf-spot. Many fields were ploughed in as a result of the epidemic.

Potato Blight.

1.—SUSCEPTIBILITY OF VARIETIES.

All the early varieties grown in Devon and Cornwall are very susceptible to Blight. Maincrop varieties are grown in parts of Devon and S.E. Cornwall chiefly for the Exeter and Plymouth markets, and the varieties favoured are Great Scot and Kerr's Pink. It is fortunate that these are two of the most resistant commercial varieties. In a severe blight season like 1931 they do not escape loss, but in a normal season on the higher ground they may remain free from the disease on both foliage and tubers. Of the other varieties grown Field Marshal and King Edward command a high price and would, no doubt, be more extensively grown if they were not so exceedingly susceptible to blight. Majestic is a valuable variety and shows a certain amount of resistance to the disease.

In 1930 the behaviour of Keay's Champion and of Evergood was compared with that of King Edward at Seale-Hayne College, a small quantity of tubers of each being planted in a plot of the King Edward. The disease appeared on Champion a few days before it appeared on King Edward, and the progress of the decay on the leaves was quite rapid. The haulms remained green and stood out in marked contrast to the decayed King Edward plants for about three weeks. The crop was lifted on October 16th, and was free from disease.

Evergood showed greater resistance than Keay's Champion, the leaves being less rapidly attacked, and the stalks stood out in the same way.

In 1931 a small plot of nine different varieties was planted on June 4th at Seale-Hayne College. Blight was contracted from a neighbouring large plot of King Edward, and its progress was observed. The relative rates indicating the order of susceptibility starting with the most susceptible are shown in the following table.

Variety	Blight appeared.	25% foliage decay after.	80% foliage decay after.
Duke of York	July 5	12 days	25 days
King Edward	do.	do.	do.
Up-to-date	do.	do.	do.
Herald	July 13	do.	22 days
Alanah	July 5	24 days	32 days
Dunbar Cavalier	do.	26 days	44 days
Kerr's Pink	do.	27 days	30 days
Great Scot	do.	29 days	38 days
President	July 17	27 days	—

2.—RELATION TO THE TIME OF PLANTING.

The experiment was carried out on the same lines as in the last two years described in previous Reports. The same variety, King Edward, was used, and the seed was obtained from Northumberland. Two series of plots were planted on the following dates :—

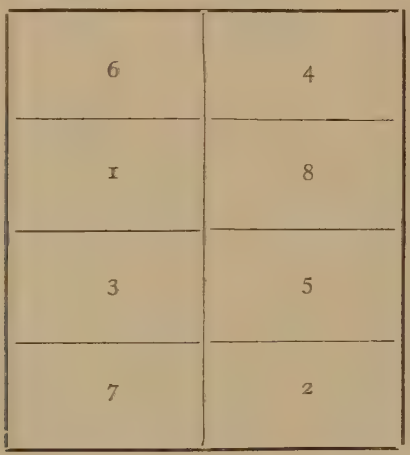
Series A. March 24, April 7, 21, May 5, 19, June 2, 17, 30.
Series B. April 22, May 6, 20, June 3, 10, 17, 24, July 1.

A was near to two of last year's plots ; it was manured with dung and artificials. B was an isolated piece of waste ground which had been bastard trenched during the winter. It was dressed with artificials only and its situation was not so sheltered as A.

Blight appeared on A before all the plantings had been completed. On June 11th lesions were observed on 22 plants in the headland rows adjoining plot 4, which was the first to be attacked, three plants showing the disease on June 12th. The figures for the number of plants attacked each day are as follows. There were 42 plants in each plot, arranged in seven rows.

Date. Plot	1	2	3	4	5	6	7	8
June 15	1		2	6				
,, 17	1		1	11				
,, 19		1	1	18	1			
,, 20	1	1	1	19				
,, 21	1	3	1	21				
,, 24		8	1	36	8			
,, 25		10	1	27	14			
,, 28	37	36	26	40	all	28		
,, 30	40	all	38	40	all	32		
July 5-11		.....		all	.....			
,, 13-17		.....		all	.....		all	
,, 18		.....		all	.....			all though only 11in. high.

The progress of blight was not, therefore, according to the time of planting, but depended on the proximity of the plots to the original source of infection, as shown in the diagram. (Source of infection indicated by x).



The disease spread slowly from plant to plant, and therefore more quickly down the rows than across them. The prevailing winds were westerly, which would tend to check the spread of the disease to the plots on the left. These results cannot therefore be cited in discussing the comparative susceptibility of different times of planting. It is interesting to note that plot 7 did not appear till July 5th, and plot 8, July 13th, by which time they were completely surrounded by diseased plants, and all the plants in each plot developed blight simultaneously.

In series B blight was not so early in appearing, but its progress was equally rapid. It began on July 11th in the headland plants above plot 8 and on July 13th in plots 1 and 2. Number of plants in each plot 60-64 (seven rows).

Date.	Plot	1	2	3	4	5	6	7	8
July	13	5	2						
,,	15	30	2	18	18				
,,	17	all	all	all	40	8	2		
,,	19				42	all	38	all	7
,,	22				all		all		all

In this series blight developed in fairly close relation to the time of planting. The arrangement of the plots was not quite the same as in A, viz., W. row 3, 5, 7, 2 ; E. row 8, 1, 4, 6. The surrounding headland infection was much more nearly uniform than in A, but there was an exceptional amount near plot 7, which explains the rapid decay of the latter.

3.—RELATION TO THE WEATHER.

In the two previous reports the weather conditions prescribed by workers in Holland as likely to result in an outbreak of blight were summarised and applied to the weather data obtained at Seale-Hayne College. Observations of cloudiness are now no longer made at this station, and the factor was therefore replaced by sunshine, which was fixed at not more than 5 hours. Favourable days in 1931 were found to be June 8, 17, 18, 23, July 2, 3, 6, 11, 13, 16, 25, 28, August 6, 12. Local outbreaks of blight occurred about June 15, and were generally severe, but the main epidemic did not begin until July 11. Comparison with the previous seasons shows that the conditions were much more favourable to blight, which was correspondingly more severe. The value of the Dutch rules in indicating when there is a danger of blight is once again demonstrated, even though blight does not appear quite as readily as the rules predict.

A study of the relative humidity gives a still more accurate picture of the conditions favouring the development and progress of blight. A continuous record was obtained by means of a self-recording hygrometer placed under a ventilated screen close to the potato plot. A comparison with the three daily wet and dry bulb thermometer readings at the weather station showed, however, that the latter method gave a satisfactory idea of the range of humidity during the day ; but it is important not to omit the afternoon reading. Humidity was high (75% or over) throughout the day on the following dates :—

May 10 to 13, 15, 16, 21, 23, 24, 27 to 31.
June 2, 4 to 12, 16, 17, 24.
July 2, 3, 4, 9 to 15, 18, 24, 26, 29, 31.
August 4, 5, 7, 8, 10, 13, 16, 19, 20, 23, 24, 27 to 31.

The two exceptionally favourable periods were June 4th to 12th and July 9th to 15th. Those fields which escaped blight in the first period all succumbed to the second, so that the general distribution of the disease in the county was evidently closely

linked up with the spells of high humidity. The humidity was remarkably high as well as long continued during these two periods. The averages for each seven day period were :—

	9h.	15h.	21h.
June 5 to 11	93.5%	93.5%	95.0%
July 9 to 15	87.7	84.1	93.4

On June 9, 10, 11, July 12, 14 the humidity was over 95% all day, practically a saturated atmosphere.

The only other periods of high humidity longer than two days were at the beginning and end of May. The shoots were only just coming through the soil about the 12th of May and the second period may be regarded as part of the June spell. It would, of course, be expected that high humidity periods are more favourable to blight as the season progresses since the mean temperature is rising.

The favourable humidity conditions in 1931 are clearly shown by the following table in which the average humidity is given for the three readings for each month. The data of 1929 and 1930 are given for comparison ; in these years blight was much less severe and did not begin till August.

Month.		Average Relative Humidity 9h.	15h.	21h.
1931	May	78.7%	74.7%	91.1%
	June	81.9	76.6	90.2
	July	80.0	76.4	91.4
	August	80.1	74.5	88.5
1930	May	74.9	69.7	85.5
	June	70.7	62.8	82.6
	July	73.1	68.3	86.8
	August	82.5	74.5	91.7
1929	May	74.6	66.2	84.7
	June	73.5	69.7	85.2
	July	70.5	63.7	84.4
	August	78.0	72.1	88.6

In each year the critical humidity for the development of blight appears to be over 70% for the average of the afternoon readings.

Chocolate Spot of Beans.

In the Second Annual Report, p. 11, an experiment was described, the object of which was to ascertain if heavy dressings of potash would prevent Chocolate Spot in broad beans. The experiment was carried out for several years, but with negative results, as the disease failed to appear. Experience has also shown that it is necessary to carry out the experiment on a large area, as the disease attains epidemic proportions only on the field crop. It has not been possible to arrange such an experiment but soil analyses have been obtained, which show the close relation of the disease to potash deficiency of the soil.

In 1927 the disease was severe on Field Beans at Instow in North Devon. The potash was estimated after extraction from the soil with citric acid, and was 0.0146% on the headlands, where the disease was very slight, compared with 0.0048% in the rest of the field.

Several epidemic attacks occurred in 1931 and the soils were analysed by the Advisory Chemist. A different method, not comparable with the above, was used, the exchangeable potash being extracted by one-twentieth normal hydrochloric acid and estimated volumetrically by the cobaltinitrite method. On Field Beans almost complete loss was suffered at Newton Abbot (potash .016%) and at Widworthy (.0108%). Both these figures are very low.

Broad Beans grown as a field crop are equally susceptible. At a farm in East Devon, where heavy dressings of potash salts were given, two fields were planted, the exchangeable potash of which was estimated as 0.0405% and 0.0316%. In the former Chocolate Spot was only moderate and rather severe in the second, though less serious than on the field bean crop already mentioned. At Penryn, in Cornwall, the usual dressing of potash salts had been omitted by the grower by an oversight and Chocolate Spot was rather severe.

In order to make a fair comparison of different fields it is necessary to know the available phosphate as well as the exchangeable potash in the soil. The different data may be summarised as follows :—

Place.	Phosphate	Potash
Widworthy	.0114%	.0108%
Newton Abbot	.037	.016
East Devon	.022	.0405
Do.	.048	.0316

From the table it will be seen that although the diseased field in East Devon was richer in potash it was almost as badly off as the other farms when the amount of phosphate is borne in mind.

Farmers who grow beans are recommended to send soil samples to Seale-Hayne College for analysis so that their potash requirements can be ascertained. On many Devon soils 5 to 8 cwt. potash salts should be applied.

The Control of Strawberry Fruit Rot.

In the last Report a description was given of a fruit rot of strawberries caused by the fungus *Phytophthora cactorum*. The appearance of the disease followed a locally heavy rainfall. In 1931 wet weather at the critical time was much more widely experienced and as a result the disease appeared in many gardens in the Tamar Valley, being found in Devon as well as in Cornwall. Serious loss was confined to the older plantations, but on many of these the crop was reduced by between 50% and 100%, so that the total loss was very great.

During the last ten days of May rain fell every day. The first three weeks of June were also wet, and during the whole of this period (May 22nd to June 20th) the ground remained wet with scarcely a day's exception. The disease was first observed in the variety Madame Lefebvre on June 8th before the fruit was fully formed, and it had probably begun several days before.

Other varieties were less severely attacked, depending on their habit of growth and time of ripening. In a garden where the disease was very severe (Madame Lefebvre losing 80-100% in different beds) Royal Sovereign and King George were badly attacked, though much less than Madame Lefebvre, and Oberschlesien was moderately attacked. Madame Kooi and Tardive de Leopold were almost completely free. The former variety has much foliage, and its fruits are borne on long stalks, so that there is little danger of soil splashing on to them, and Tardive de Leopold is a late variety.

Dusting experiments to control the disease were carried out by the Cornwall County Council's horticultural staff, and were reported in the press (e.g. *Fruit Grower*, June 25th, 1931). A few growers dressed the beds with straw before the disease appeared, and the results were very striking. Complete control was obtained. Where an occasional fruit had been attacked, it had evidently been in contact with the soil through a gap in the straw. In one case the strawing of the field had been left incomplete, and the fruits on the side of the row where straw lay were perfectly healthy, while those on the other side, unprotected from the soil, were nearly all decayed.

APPENDIX 1.

PESTS REPORTED FROM DEVON AND CORNWALL.

This list comprises those insects not reported in the seven previous years and those occurring on host plants previously unrecorded.

CEREALS.

Pest.	Crop.	Remarks.
Orthoptera.		
Oryzaephilus surinamensis (L) and *Calandra granaria* (L).	Stored Oats.	A very severely infested store investigated at Truro.

BRASSICAE.

Diptera.		
Contarinia nasturtii (Kieff).	Rape.	Some injury general throughout S. Devon.
Collembola.		
Bourletiella hortensis (Fitch).	Broccoli.	Occurred in enormous numbers on field crops near Penzance, but doubtful if doing injury.
Myriopoda.		
Millepedes.	Broccoli.	Very injurious in West Cornwall in November.
Mollusca.		
Helix pomatia (L).	Broccoli.	Some damage in West Cornwall.
Rodents.		
Field Voles.	Broccoli.	Severe injury to plants reported in March.

VEGETABLES.

Diptera.		
Psila rosae (F).	Parsnip.	Severe around Plymouth.

FRUIT.

Lepidoptera.		
Acronycta rumicis (L).	Strawberry and Apple.	Numerous larvae noticed on these crops.
Acarina.		
Tarsonemus fragariae (Zimm).	Strawberry.	Widespread throughout province, and causing much injury.

FLOWERS.

Coleoptera.		
Otiorrhynchus sulcatus (L.)	Chrysanthemum.	Injuring stools, Truro.
Orthoptera.		
Blatta orientalis (L.)	Sweet Pea.	Quantities of seed destroyed under glass.
Diptera.		
Anthomyidae.	Chrysanthemum.	Unidentified larvae causing considerable injury to roots of stools and cuttings, Bere Alston.
Rhynchota.		
Capsidae.	Chrysanthemum.	Severe injury to flower beds noted Devon and East Cornwall.
Myzus circumflexus (Buckt.)	Arum Lily.	Severe infestation of commercial house noted, East Devon.
Myzus persicae (Sulz).	Gladiolus.	Severe in store. Fumigation with para-dichlorbenzine effective.
Mollusca.		
Agriolimax agrestis (L.) and *Arion hortensis* (Ferussac).	Narcissus.	Numerous cases of damage to forced blooms checked by use of poison bait.
Rodents.		
Mice.	Tulip.	Severe injury to newly-planted bulbs. Traps baited with Tulip efficient; cheese ineffective.

MISCELLANEOUS.

Lepidoptera.		
Pachys betularia.	Willow.	Some defoliation of commercial beds noted, South Devon.

APPENDIX II.

FUNGAL DISEASES OF DEVON AND CORNWALL.

The following are additions to the Lists of Diseases given in previous Annual Reports.

I.—DISEASES FOUND IN BOTH COUNTIES.

CEREALS.

Wheat.
Leaf Spot (*Septoria Tritici* Desm.)

ROOTS.

Sugar Beet.
Black Leg (*Phoma Betae* Frank and *Pythium de Baryanum* Hesse).

VEGETABLES.

Lettuce.
Bacterial Spot (*Bacterium marginale* N. A. Brown).

Tomato.
Sleepy Disease (*Verticillium albo-atrum* Reinke and Berth.)

FRUIT.

Apple.
Sooty Blotch (Fungus undetermined).

Gooseberry.
Cluster Cup Rust (*Puccinia Pringsheimiana* Kleb.)

Strawberry.
Fruit Rot (*Phytophthora Cactorum* Schroet.)

Grape Vine.
Mildew (*Uncinula necator* (Schw.) Burr.)

FLOWERS.

Azalea.
Gall (*Exobasidium Vaccinii* (Fuck.) Woron.)

Carnation.
Ring Spot (*Heterosporium echinulatum* (Berk.) Cooke).

Iris.
Bulb Scab (*Mystrosporium adustum* Massee).

Sweet William.
Rust (*Puccinia Lychnidearum* Link f. *Dianthi* Grove).
Leaf Spot (*Ascochyta Dianthi* Berk.)

II.—DISEASES FOUND ONLY IN DEVON.

PULSE.

Pea.

Stem Rot (*Mycoshpaerella pinodes* (Berk. and Blox.) Niessl.)

FORAGE CROPS.

Marrow Stem Kale.

Stem Rot (*Phoma Lingam* (Tode) Desm.)

VEGETABLES.

Cucumber.

Mildew (*Erysiphe Cichoracearum* DC.)

Lettuce.

Downy Mildew (*Bremia Lactucae* Regel).

Ring Spot (*Marssonina panattoniana* Berl.)

FRUIT.

Apple.

Bud Rot (*Fusarium* sp.)

Apricot.

Leaf Curl (*Taphrina deformans* (Berk.) Tul.)

Walnut.

Root Rot (*Armillaria mellea* (Vahl) Fr.)

FLOWERS.

Campanula.

Brown Wilt (*Sclerotinia Sclerotiorum* (Lib.) de Bary).

Hyacinth.

Soft Rot (*Bacillus carotovorus* L. R. Jones).

MISCELLANEOUS.

Willow.

Black Canker (*Physalospora Miyabeana* Fukushi.)

Thuja.

Thuja disease (*Keithia thujina* Dur.)

III.—DISEASES FOUND ONLY IN CORNWALL.

FRUIT.

Loganberry.

Leaf Spot (*Plectodiscella veneta* Burkh.)

FLOWERS.

Chrysanthemum maximum.

Blotch (*Septoria chrysanthemella* Sacc.)

Muscari.

Soft Rot (*Bacillus carotovorus* L. R. Jones).

Seale-Hayne College Pamphlets.

Pamphlet 3. The Charlock Danger.
,, 4. The Feeding of Cows in Relation to Milk Production.
,, 5. Plants Poisonous to Stock and First Aid.
,, 6. Tariff of Analyses.
,, 7. Field Experiments for 1922. (Out of Print).
,, 8. Simple Farm Book-keeping for Income Tax Purposes. (Out of Print).
,, 9. Feeding Potatoes to Pigs.
,, 10. First Report on the Cost of Food in Milk Production in Devon and Cornwall. (Out of Print).
,, 11. Milk Tainting Plants and Some Stored Milk Troubles.
,, 12. Second Report on the Cost of Food in Milk Production in Devon and Cornwall.
,, 13. Variety Trials with Oats.
,, 14. Spotted Medick.
,, 15. Potato Variety Trials, 1924.
,, 16. First Annual Report of the Department of Plant Pathology.
,, 17. Cost of Milk Production. (3rd Report). (Out of Print).
,, 18. Potato Variety Trials, 1925.
,, 19. Second Annual Report of the Department of Plant Pathology.
,, 20. Potato Variety Trials, 1926.
,, 21. Third Annual Report of the Department of Plant Pathology.
,, 22. Purity of Strain in Red Clover.
,, 23. Economic Investigation of Devon and Cornish Farms.
,, 24. Variety Trials with Potatoes. Four years. (Final Report). (Out of Print).
,, 25. Fourth Annual Report of the Department of Plant Pathology.
,, 26. Grassland Management. (Out of Print).
,, 27. Report of the Advisory Departments.
,, 28. Tables of Composition, Nutritive and Manurial Values of Foods.
,, 29. Report on the Elimination from a Dairy Herd of Cows reacting to the Tuberculin Test.
,, 30. Fifth Annual Report of the Department of Plant Pathology.
,, 31. Sixth Annual Report of the Department of Plant Pathology.
,, 32. The Manufacture of Butter.
,, 33. Sugar Beet Costs in Devon and Cornwall.
,, 34. Guide to Exhibit at the World's Poultry Congress (1930).
,, 35. Clotted Cream.
,, 36. Seventh Annual Report of the Department of Plant Pathology.

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